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Pulse Plasma Ion Assisted EB-PVD with doping by ion sputtering of additional targetAnatoly Kuzmichev¹¹NTUU Kiev Polytechnical Institute, Kiev, Ukraine

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Plasma ion assisted physical vapor deposition with electron-beam evaporation (PIA-EB-PVD) is one of commonly used methods for deposition of various coatings. The characteristics of coatings may be improved when a pulse modulated negative bias is applied to substrates. The traditional EB-PVD has drawback in non-congruent evaporation of composite ingots consisting from components with different rate of evaporation. Such case occurs during deposition of alloys Ti-8Al-1V-1Mo, Ti-6Al-2Sn-4Zr-2Mo, etc. The drawback may be overcome if one uses EB evaporation of non-refractory components and their vapor ionization in combination with matched metal-ion sputtering of additional targets from refractory components. This approach has been studied for PIA-EB-PVD of Ti-8Al-1V-1Mo coating. A negatively biased target, made from refractory metal (Mo), was sputtered by metal ions (mainly Ti⁺) generated in low-voltage arc discharge, existing in metal vapor, which, in turn, was generated due to EB heating of an ingot. The ingot was of Ti/Al/V composition. The Mo target was disposed in the vicinity of the substrate; the lower (back) target surface was shielded from the metal vapor flow. The EB power was 40 kW. The arc discharge current was 50-200 A. The substrate bias voltage was pulse modulated (pulse frequency $F = 1$ kHz, duty cycle $D = 0.1-0.9$, $-U_{bias} = 0-2$ kV). The sputtering coefficient for Mo/ Ti⁺ calculated with help of the TRIM code is about 2 for ion energy 2-3 kV, therefore the maximum target bias voltages was -2.5 kV and was also pulse modulated ($F = 1$ kHz, $D = 0.9$) for preventing arcing on the target surface. The experiments showed that Mo content in the deposited alloy was up to 2 w.% and could be regulated by variation of the target bias. Thus, one can see introducing the negatively biased target into ionized metal vapor allows doping the deposited composite coating with the target metal in the controllable mode.

Keywords

EB-PVD

pulse ion assisted PVD

PVD with doping

ion sputtering

pulse sputtering